

Foodborne Epidemic of Group A Beta Hemolytic Streptococcus

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A SUDDEN extensive outbreak of beta hemolytic streptococcal sore throat occurred in Baltimore, Md., during February 1957. The Baltimore City Health Department, investigating the outbreak, found that an estimated 600 individuals became ill following attendance of a charity luncheon by more than 800 people, mostly women.

Several members of the organization which sponsored the luncheon procured and prepared most of the food served. A commercial caterer and a restaurateur assisted in the preparation of some of the food. The menu consisted of egg salad, tuna fish salad, macaroni with cheese, cottage cheese with nuts and cherries, pickles and olives, ice cream, coffee, and cookies.

Epidemiologically, egg salad, the probable vehicle of the outbreak, is of interest because recent literature reveals three instances in which eggs were the vehicle of transmission for streptococcus infection (1-3).

The specific causative organism, group A, type 25, beta hemolytic streptococcus which was recovered from patients, is one of the types of streptococci reported as being nephrotoxic by Rammelkamp and others (4-7).

Epidemiological Studies

A questionnaire was distributed 1 week after the luncheon to as many people who had attended as possible. It soon became apparent

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that it would be impossible to reach all of these people, since there was not a complete roster of the guests.

Because of the incomplete roster and because of the possibility that the questionnaires would be returned primarily by those ill, it was decided to base the epidemiological investigation primarily on the information obtained from the 96 members of the organization.

The questionnaire requested the following information: clinical details of the illness, time of onset of the illness, name of the attending physician, a history of foods eaten at the luncheon, a statement on whether any food had been taken home and, if so, who had eaten it and with what result.

Of the 96 members of the organization 6 had not attended the luncheon and 4 could not be found for questioning. Of the remaining 86 members, 60 had become ill with sore throats, giving an attack rate of 70 percent. Since it is reasonable to assume that the attack rate of this group is unbiased, it follows that of the 800 to 900 who attended the luncheon, some 500 to 600 probably became ill. This figure does not include secondary cases or those who were made ill by food brought home.

Figure 1 gives the frequency distribution in hours of onset of the illness following the luncheon. The shape of the curve, although slightly skewed to the right, is nevertheless consistent with the hypothesis of a common source epidemic.

By plotting the cumulative percentage of cases against the logarithms of the times of onset on normal probability paper (fig. 2) according to the method of Sartwell (8), the

points fall approximately along a straight line in a log normal fashion. From this graph the median incubation is estimated to be 31-32 hours, with 90 percent of the cases occurring within 65 hours following the luncheon. In the Fort Bragg outbreak (1) the estimated median incubation period was 38 hours, and in the Catskill epidemic reported by Sartwell (8) it was 56 hours.

Of the 60 members who became ill, all except 1 had a sore throat; 40, or 66.7 percent, had fever; 32, or 53.3 percent, had headaches; vomiting was reported by 11.5 percent, and 6.7 percent experienced diarrhea. There were no reported instances of a skin rash. There were no fatal cases.

Table 1 summarizes attack rates according to the food histories given by the 86 organization members. The outstanding observation is that, of 65 individuals who ate egg salad, 83 percent subsequently became ill and among the remaining 21 who did not eat egg salad, 29 percent became ill. For each food, the noneaters serve as a control for those who gave a history of

Figure 1. Frequency distribution of persons attacked, by time of onset of illness.

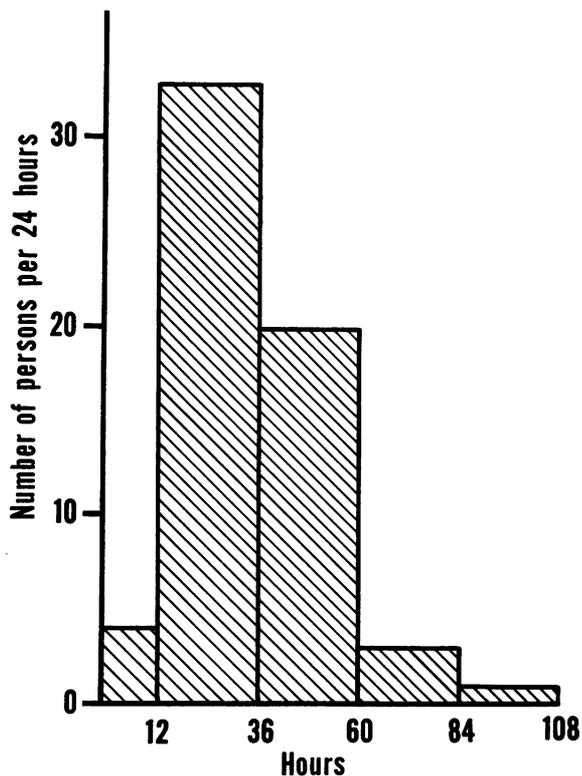
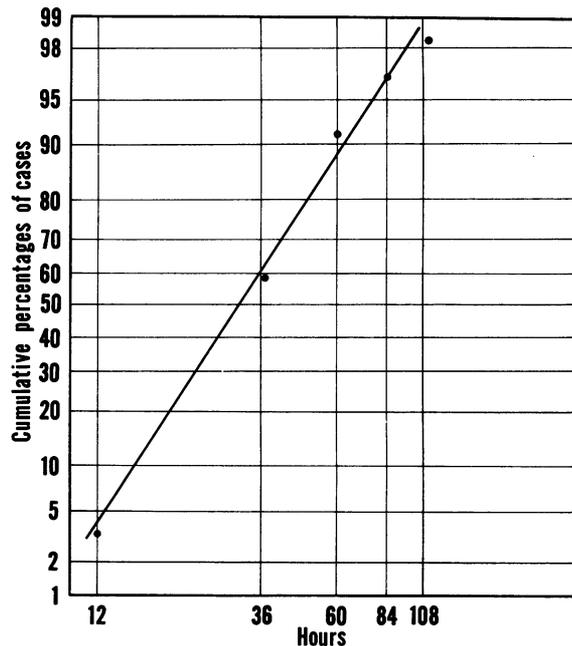


Figure 2. Cumulative distribution of persons attacked, by time of onset of illness.



eating. Where the attack rate differs significantly between the consumers and the nonconsumers, the foodstuff is said to be associated with the illness and is suspect as the vehicle of the illness. In the present investigation, egg salad and tuna fish salad are thus conjectured as possible sources of infection, egg salad showing a far higher association.

A factorial analysis, shown in table 2, indicates that among those who ate tuna fish salad, the attack rate was significantly determined by the consumption of egg salad. However, among those who ate egg salad, a history of tuna fish salad eating was not significant as a determinant of illness. These facts would seem to indicate that egg salad was the vehicle of the illness.

Further support for incrimination of the egg salad is provided by the analysis of the incidence of illness among husbands and other family members who were not in attendance at the luncheon, but who ate the leftover food brought home by the ladies. As shown in table 3, of those who ate the egg salad only, 71 percent became ill; whereas of those who ate the tuna fish salad only, 13 percent became ill. Of those who ate both egg salad and tuna fish salad, 59 percent became ill. There are certain limitations, of course, in this analysis. The in-

Table 1. Attack rates, according to food history

Food	Persons who ate specified food			Persons who did not eat specified food				
	Total number	Number ill	Percent ill	Total number	Number ill	Percent ill	χ^2	¹ P
Egg salad.....	65	54	83.1	21	6	28.6	24.75	<.01
Macaroni and cheese.....	34	26	76.5	52	34	65.4	.95	>.05
Cottage cheese.....	56	40	71.4	30	20	66.7	.25	>.05
Tuna fish salad.....	63	49	77.8	23	11	47.8	7.02	<.01
Ice cream.....	40	31	77.5	46	29	63.0	1.99	>.05

¹ Values shown represent probabilities that observed differences could have occurred by chance. Values of $P < .05$ indicate statistically significant differences.

cidence of illness among members of the households who did not eat the leftover foods was not obtained. This information could have provided an estimate of the expected incidence in the absence of a history of exposure to suspected foods, either due to spread of the agent (secondary cases) or unconnected with the episode.

Investigation of the preparation of the foods strengthened the evidence that the egg salad was the vehicle of spread. The tuna fish salad and cottage cheese had been prepared by the caterer, whereas the egg salad had been prepared by the restaurateur. The tuna fish had been supplied in unopened cans to the caterer, and the mayonnaise was a well-known commercial brand in large unopened gallon jars. The cottage cheese was secured from one of the large milk plants in Baltimore City. The macaroni and cheese had been prepared at the luncheon and served hot.

The raw eggs for the egg salad were obtained from various sources by the ladies of the organi-

zation. In the homes of eight members they were hard-boiled and shelled by the ladies with the help of maids and others on Monday, February 4. The hard-boiled eggs were then collected from these homes and delivered to the restaurateur some time on Tuesday, February 5, the day before the luncheon.

At the restaurateur's, on the evening of February 5, the peeled, boiled eggs were cut by machine and mixed with washed, cut-up celery. The room temperature was said to be between 78° to 82° F. Mayonnaise from the original containers, seasoning, and a quantity of mashed potatoes were added. This mixture was excessively handled, being run through the grinder three times, and then put in plastic bags of approximately 25 pounds each. These were sealed and placed in the restaurant refrigerator for approximately 9 hours at a temperature reported as 34° F. There are indications that this food was not completely chilled until after many hours storage in the refrigerator.

Table 2. Attack rates, comparison of egg salad with tuna fish salad

Food eaten	Total number	Number ill	Percent ill	P
Egg salad without tuna fish salad.....	12	8	66.7	} >.05
Egg salad with tuna fish salad.....	53	46	86.8	
Total.....	65	54	83.1	
Tuna fish salad without egg salad.....	10	3	30.0	} <.01
Tuna fish salad with egg salad.....	53	46	86.8	
Total.....	63	49	77.8	
Neither egg salad nor tuna fish salad.....	11	3	27.3	

Table 3. Attack rates, not present at luncheon but eating food brought home

Food taken home	Number eating food	Number ill	Percent ill
Egg salad only.....	38	27	71. 1
Tuna fish salad only.....	15	2	13. 3
Egg salad and tuna fish salad.....	21	12	57. 1

Upon investigation of the food handlers at the restaurateur's where the egg salad had been prepared, it was discovered that one of them had been examined at a local hospital for severe cellulitis of his left hand on February 7, the day following the luncheon and 2 days following the preparation of the egg salad. The following is an abstract of his hospital outpatient record:

Present illness: Patient states that on several occasions he has had pus pimples on his hands. This time, the present episode began yesterday, and his left hand became swollen and sore. There are also pus pimples on the right hand.

Physical examination: Discloses erythema and edema of fingers of the left hand, and also hand itself is edematous. Increased temperature in area. Linear red streak up the flexor surface of left forearm and up the arm into the left axilla where there is a large axillary adenitis present.

Diagnosis: Pustular dermatitis, both hands; cellulitis, left hand; lymphangitis, left arm; lymphadenitis, left axilla.

No cultures from the food handler were taken at the hospital. Cultures from this man's hand and throat were subsequently obtained in the Baltimore City Health Department on February 11, 6 days after the preparation of the egg salad. In addition, throat cultures and hand cultures were taken on February 11 from 2 other food handlers who likewise were involved in the preparation of the egg salad. The report on these cultures will be discussed under the laboratory findings.

The food handler with cellulitis insisted that his hands were normal at the time of the preparation of the egg salad and that they did not become sore until 24 hours later. This fact is borne out in the above abstract from the hospital record where it is clearly stated that the infection of the hands began "yesterday," that

is, on February 6, the day after preparation of the egg salad. This information in the hospital record was given before there was any suspicion that a foodborne epidemic was involved. The previous occurrences of "pus pimples," according to the food handler, followed exposure to mayonnaise, vinegar, and certain detergents. They may have represented contact dermatitis.

Laboratory Findings

Six throat cultures were obtained from patients who had attended the luncheon. Four of these were taken by the health officer and two by a private physician on February 8, 2 days after the luncheon. These cultures were examined in the laboratories of the Baltimore City Health Department and typed at the Johns Hopkins School of Hygiene and Public Health. Five cultures were reported to have grown beta hemolytic streptococcus, group A, using the Taxos disk method. From the sixth culture an alpha streptococcus and a hemolytic, pigmented, coagulose positive staphylococcus were isolated. Further typing of the group A culture indicated that 3 of the 5 were type 25; one was untypable and the fifth culture was group C instead of the originally thought group A.

Throat cultures taken on February 11 from the 3 food handlers who had prepared the egg salad showed beta hemolytic streptococci, which were later typed as group A, type 25. It is of interest that the food handler with cellulitis of the left hand still had a positive throat culture in spite of 3 intramuscular injections of 600,000 units of penicillin, given on February 7, 8, and 11.

Cultures from the hands of these food handlers, including the one with cellulitis, were negative for beta hemolytic streptococci.

Bacteriological examinations of the samples of the egg salad, tuna fish salad, and cottage cheese were done as follows: 10 grams of each were emulsified in 90 cc. of sterile buffered distilled water. Serial dilutions were made and plated for total and coliform counts. A tenth of a cubic centimeter of the emulsion was plated on Teague's EMB, blood, tellurite glycine, and desoxycholate lactose saccharose citrate agars. Selenite enrichment broth was also inoculated

for plating in 24 hours. The organisms isolated were tested for biochemical reactions and in the case of the pigmented staphylococci, the Stone's agar and coagulose reactions were tested.

Beta hemolytic streptococci were not isolated from any of the food samples, but the egg salad was heavily contaminated with *Escherichia coli*; hemolytic, pigmented staphylococci; and alpha streptococci. From the cottage cheese a hemolytic pigmented staphylococcus and an alpha streptococcus were isolated. Only an alpha streptococcus was isolated from the tuna fish salad.

Four weeks after the luncheon 9 throat cultures were taken at random from 9 women who had had acute sore throats following the luncheon. Of these, three were positive for a group A, type 25, beta hemolytic streptococcus. At the time the cultures were taken, all of these ladies were asymptomatic and had apparently fully recovered from their acute illness. None of the nine had been cultured previously in the investigation.

Thus, group A, type 25, beta hemolytic streptococci were isolated from 3 of 6 attendants at the luncheon who were cultured 2 days later, from all 3 food handlers cultured 5 days after the luncheon, who prepared the egg salad, and from 3 of 9 attendants at the luncheon who were cultured 4 weeks later.

Complications

Since the causative organism, group A, type 25, beta hemolytic streptococcus, had been cited as being nephrotoxic, a survey was initiated to estimate the frequency of nephritic as well as other complications. The survey was timed to coincide with the maximum time interval between the acute sore throat and the onset of possible nephritis, that is, 21-28 days (9). Physicians practicing in the area where the majority of the patients lived were questioned and alerted to this possibility. Questionnaires were sent to 47 of the physicians known to have treated some of the patients. Of these, 33 responded and reported that they had treated a total of 310 patients. None of these patients was reported to have had any signs of nephritis within 5 weeks after the acute attack; 51 of the 310 had recurrences of sore throat after ap-

parent initial recovery. Other complications reported were 3 cases of sinusitis and 3 cases of otitis media.

In addition to the questionnaires to the physicians, single urine specimens were obtained by the public health nurses of the Baltimore Health Department from 97 of the ladies, including members and nonmembers, who had had sore throats. The specimens were obtained during the fourth week following the acute illness. These 97 specimens were tested within 6 hours of collection for the presence of albumin and red blood cells. All of the tests were negative except one which showed a two-plus albumin and 1 to 2 red blood cells per high-power field. In this latter case, the patient's personal physician was contacted and his further investigation revealed no evidence of nephritis.

Discussion

The estimated primary attack rate for this foodborne streptococcus outbreak, 69.8 percent, was high compared with other reported outbreaks. The Fort Bragg attack rate was 41.7 percent, of which 91 percent were primary cases and 9 percent were carriers (1). There are several possible explanations for this difference. The causative organism in the present outbreak may have been new to this community so that the number of previously immune individuals was low. Since the typing of streptococci is a recently adopted procedure and not regularly performed, there is no evidence to refute or substantiate this possibility.

A more likely possibility derives from the fact that both the health department investigators and the private physicians gained the impression that several of the so-called patients were not truly infected but merely had psychosomatic complaints. In addition, the fact that only two-thirds of the reported patients had fever seems unusually low for streptococcal sore throat and therefore supports this contention.

Consistent epidemiological evidence suggests egg salad was the vehicle for the disease: first, the epidemic curve indicated that the reported disease was due to a common vehicle; second, the analysis of attack rates according to foods

consumed implicates egg salad as the determinant of the sore throat; third, the analysis of attack rates among those who ate food brought home from the luncheon also points to the egg salad; and fourth, the causative organism was isolated from the throats of the food handlers who prepared the egg salad. The failure to isolate the organism from the egg salad may perhaps be explained by the fact that at the time food samples were cultured, the egg salad was at least 72 hours old, and the eggs themselves had been shelled approximately 96 hours. Presumably, any beta hemolytic streptococci that might have been present could have been overgrown with other organisms.

The inability to find the causative organism in the vehicle demonstrates the need for epidemiological investigation of all illnesses attributed to food, and the inherent limitations in inferences based solely upon the results of analyses of residues of food served. Food available for examination following any outbreak of illness is food that has not been eaten, and unless of liquid consistency a negative finding cannot be considered to refute the epidemiological findings.

The means by which the egg salad was contaminated pose an interesting question. If we accept the possibility that the man with cellulitis was a victim rather than the initiator of the outbreak, then we must look elsewhere for the mode of infection of the egg salad.

Any one of the ladies, or their maids and other helpers, who helped to prepare the eggs could have been a carrier of the streptococcus and could have coughed or sneezed inadvertently over her pile of shelled hard-boiled eggs. If the eggs were so inoculated and improperly refrigerated overnight in the ladies' homes, an ample growth of streptococci could have been present the next day when the eggs were delivered to the restaurateur.

The food handler could have been infected when he was putting the eggs through the cutting machine. An attempt to test this hypothesis was made. All the ladies involved in the preparation of the eggs were questioned, but they denied any infection or illness prior to the luncheon either in themselves or in members of their families. Of these 8 ladies all but 2 became ill 24 to 48 hours after the luncheon.

In addition, absentee records of schools in the vicinity were examined for evidence of sore throats. The only apparently pertinent information thus obtained was that the young son of one of the members was sick with a sore throat and fever 4 days before the luncheon. Investigation of this lead revealed that the whole family except the mother had been sick. The mother however could not be connected with the preparation of the eggs or any of the other foods served.

The positive throat cultures from the 3 food handlers at the restaurateur's taken on February 11, 1957, 5 days after the luncheon, could be explained by the assumption that each of these men sampled the egg salad during and after mixing. Investigation of this possibility revealed that two of the food handlers tasted some of the egg salad; the third could not be reached. Consequently, the question again arises whether these positive throat cultures are cause or effect.

Conclusions from the failure to find evidence of nephritis in 97 subjects must be guarded. A single urine specimen is not wholly adequate to rule out this condition, even when taken at approximately the time when nephritis would be expected to be present. The negative information secured from physicians treating over 300 patients must also be interpreted with caution. We may at least say, however, that the incidence of nephritis, if it occurred, was low. Only two cases of nephritis have been reported in the literature in association with type 25 streptococcus.

Apparently the secondary attack rate for this outbreak was low. Those private physicians who were questioned reported very few cases in other members of the families or the community except among those who ate the food served at the luncheon. Likewise, a review of the causes of absence from the schools in the area showed no marked increase in the number of acute sore throats. One possible explanation for the low secondary attack rate is the fact that many of the private physicians in the area gave routine prophylactic antibiotics to contacts of the primary cases. However, secondary attack rates appear to have been low in other foodborne streptococcal epidemics before antibiotics were used.

Even after taking into account the use of effective antibiotic therapy, the cases in this epidemic were impressively mild as contrasted with those of an earlier era when septic sore throat was attended by a considerable number of suppurative complications and a substantial mortality. This is consistent with the long-time trend toward reduced clinical severity of scarlet fever and, presumably, respiratory streptococcal infections.

Summary

In February 1957 a foodborne outbreak of streptococcal sore throat, estimated to have caused over 500 illnesses, occurred in Baltimore, Md. The attack rate was 70 percent among the 86 persons studied. The causative organism was a group A, type 25, beta hemolytic streptococcus.

Epidemiological investigation suggests that egg salad served at a luncheon was the vehicle, 83 percent of those who ate the food reporting illness. The source of the infection was not ascertained.

Although the search for nephritic complications was limited, no evidence was found to support reports of the nephrotoxic potential of this streptococcal type.

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The Biophysical Society

The first national meeting of the Biophysical Society was held at the Massachusetts Institute of Technology in Cambridge, Mass., during February 5-7, 1958.

Founded in March 1957 in Columbus, Ohio, the society has defined its aim as the promotion of "a more complete biological science with emphasis on mathematically formalized theory and quantitative experimentation." The group hopes to achieve this goal by welding into a new scientific team experts from such fields as physics, biology, medicine, chemistry, mathematics, and engineering.

Intensively studied at the 1958 meeting were aspects of molecular biophysics, particularly microsomal particles and protein synthesis, and muscle proteins and contractile mechanisms. Papers were presented by specialists drawn from the United States and abroad with the assistance of the National Science Foundation.